Eastern Illinois Integrated Conference in Geometry, Dynamics, and Topology: Abstracts

March 29-31, 2019

Jane Hawkins (UNC Chapel Hill)
Symbolic dynamics as a tool to model virus spread

Friday, March 29 at 4:30pm in Room 2011.

Coding complex processes using strings made of a small number of symbols has been around in mathematics for a very long time. We give a brief overview of the tool and its history, and then focus on a modern application. We explore some basic principles of virus dynamics and discuss how they can be modeled by symbolic coding, focusing on some dynamical properties of HIV and Ebola.

Shahriar Mirzadeh (Michigan State)
Dimension estimates for the set of points with non-dense orbit in homogeneous spaces

Saturday, March 30 at 8:30am in Room 2011.

In this talk we study the set of points in a homogeneous space whose orbit escapes the complement of a fixed compact subset. We find an upper bound for the Hausdorff dimension of this set. This extends the work of Kadyrov, where he found an upper bound for the Hausdorff dimension of the set of points whose orbit misses a fixed ball of sufficiently small radius in a compact homogeneous space. We can also use our main result to produce new applications to Diophantine approximation. This is joint work with Dmitry Kleinbock.

Chad Kelterborn (UNC Chapel Hill)
Soergel bimodules and HOMFLY-PT homology

Saturday, March 30 at 9:50am in Room 2011.

One of the goals in knot theory is to find invariants which differentiate knots. As knots have very little intrinsic data, mathematicians and physicists have found that by adding certain data to knots one can obtain knot invariants. Such a process of adding data is called decorating a knot. One such data, introduced by Wolfgang Soergel in 1992, are called Soergel bimodules. We will explore Soergel bimodules and their connections to the construction of HOMFLY-PT homology, named after its co-discoverers by combining the first initials of their last names: Jim Hoste, Adrian Ocneanu, Kenneth Millett, Peter J. Freyd, W. B. R. Lickorish, David N. Yetter, Jzef H. Przytycki, and Pawe Traczyk. For the main body of this talk, we assume that the audience is familiar with standard undergraduate abstract algebra.

Surena Hozoori (Georgia Tech)
Dynamics and topology of conformally Anosov contact 3-manifolds

Saturday, March 30 at 11:00am in Room 2041.

We will use Hofers work in contact dynamics and certain Conley-Zehnder index computations to give the first contact topological results about conformally Anosov contact structures. Conformally Anosov flows, introduced by Thurston-Eliashberg and Mitsumatsu, seem to be more of topological interest than their more well studied special case, Anosovflows and it is natural to ask about the consequences of having such dynamical property on the Reeb vector field of a given contact 3-manifold. We will see such contact manifolds are universally tight, irreducible and do not admit exact cobordism to the tight sphere. Such study also serves motivations from Riemannian geometry of contact structures and in particular contributes to the Chern-Hamilton conjecture on the energy functional of Riemannian structures compatible with a contact 3-manifold.

Alvin Jin (KTH Stockholm)
Symplectic embeddings in four dimensions

Saturday, March 30 at 11:00am in Room 2011.

Symplectic embeddings are smooth embeddings that respect symplectic structure. In 1985,Gromov proved his non-squeezing theorem, which was one of the first insights into studying such embeddings. However, not much is known still. In dimension two, symplectic embeddings correspond to area-preserving transformations. In dimension four, less is known. In this talk, I will highlight how Floer homology, number theory, and combinatorics are used in studying symplectic embeddings and also mention some recent results.

Ronnie Pavlov (Denver)
Minimal subsystems and ergodic measures for subshifts of linear complexity

Saturday, March 30 at 1:40pm in Room 2011.

A subshift X is said to have linear complexity if there exists a constant C so that the complexity function $c_n(X)$ (the number of n-letter words in X) is bounded from above by Cn. We will discuss several recent results about this class of subshifts. The first (with Nic Ormes) states that every non-degenerate transitive non-minimal subshift must have complexity growing more quickly than $1.5n$ along a sequence. The others (with Andrew Dykstra and Nic Ormes) give bounds on the number of minimal subsystems and generic measures of a transitive subshift X of linear complexity in terms of the associated constant C. The results about generic measures are related to recent work of Cyr and Kra and older work of Boshernitzan.

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Stefano Silvestri (IUPUI)
The boundary of the Mandelbrot set for a pair of linear maps

Saturday, March 30 at 3:00pm in Room 2041.

Consider two objects associated to the IFS $\{\lambda z + 1, \lambda z - 1\}$: the locus $\mathcal{M}$ of parameters $\lambda \in \mathbb{D} \setminus \{0\}$ for which the corresponding attractor is connected; an the locus $\mathcal{M}_0$ of parameters for which the related attractor contains 0. The set $\mathcal{M}$ can also be characterized as the locus of parameters for which the attractor of the IFS $\{\lambda z + 1, \lambda z, \lambda z - 1\}$ contains 0. Exploiting the asymptotic similarity of $\mathcal{M}$ and $\mathcal{M}_0$ with their respective associated attractors, I give sufficient conditions on $\lambda \in \partial\mathcal{M}$ or $\partial\mathcal{M}_0$ to guarantee it is accessible (not buried). If time permits, for a specific parameter $\lambda \in \partial\mathcal{M}$ I will describe the method used to show it is accessible from the largest connected component of $\mathbb{D} \setminus \mathcal{M}$.

Luya Wang (UC Berkeley)
Hyperbolicity of links in thickened surfaces

Saturday, March 30 at 3:00pm in Room 2011.

Menasco showed that a non-split, prime, alternating link that is not a 2-braid is hyperbolic in S^3. We prove a similar result for links in closed thickened surfaces $S \times I$. We define a link to be fully alternating if it has an alternating projection from $S \times I$ to S where the interior of every complementary region is an open disk. We show that a prime, fully alternating link in $S \times I$ is hyperbolic. Similar to Menasco, we also give an easy way to determine primeness in $S \times I$. A fully alternating link is prime in $S \times I$ if and only if it is "obviously prime". Furthermore, we extend our result to show that a prime link with fully alternating projection to an essential surface embedded in an orientable, hyperbolic 3-manifold has a hyperbolic complement.

Joint work with C. Adams, C. Albors-Riera, B. Haddock, Z. Li, D. Nishida, and B. Reinoso.

Rosemary Guzman (UIUC)
Quantitative Mostow rigidity: relating volume to topology for hyperbolic 3-manifolds

Saturday, March 30 at 4:10pm in Room 2011.

The celebrated Mostow Rigidity Theorem provides a remarkable bridge between the geometry and topology of complete, finite-volume hyperbolic n-manifolds in dimension at least 3. In particular, the topological type of a closed, orientable, hyperbolic 3-manifold M completely determines its geometry. In this talk, we aim to address the question: how can this result be quantified? We discuss previous results in this direction as well as joint work with Peter Shalen which investigates the question through the lens of imposing natural restrictions on the fundamental group of M.

Joel Moreira (Northwestern)
The Erdös Sumset Conjecture

Sunday, March 31 at 8:30am in Room 2011.

The Erdös Sumset Conjecture states that a set of natural numbers with positive density (i.e. that contains a positive proportion of all natural numbers) must contain a sum $B+C = \{b+c : b \in B, c \in C\}$ where B and C are both infinite sets of natural numbers. I will present a brief history of this and related problems, and then outline the proof of the recent solution to the conjecture, obtained in joint work with Richter and Robertson.

Colin Adams (Williams)
Hyperbolicity of Virtual Links

Sunday, March 31 at 10:00am in Room 2011.

In 1978, Thurston revolutionized knot theory by showing all knots are either torus knots, satellite knots or hyperbolic knots. Hyperbolicity has since become a critical tool for knot theory. In 1999, Kauffman invented virtual knots, which have virtual crossings in addition to the usual classical crossings. In summer 2018, students and I extended notions of hyperbolicity to virtual knots. This area provides many avenues for further research. No familiarity with either hyperbolicity or virtual knots is assumed.